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Santiago, Chile, 14 to 25 March 1966

FISHERIES INDUSTRIES

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P A P E R No. V

FISHERIES INDUSTRIES

The FAO Contribution to this Symposium includes in addition to the one mentioned above five other papers entitled:

I: ST/ECLA/CONF.23/L.19 "The Economic Significance and Contribution of Industries based on Renewable Natural Resources and the Policies and Institutes Required for their Development"

II: ST/ECLA/CONF.23/L.20 "Some Essential Requisites for Industrial Development of Renewable Natural Resources"

III: ST/ECLA/CONF.23/L.21 "Food and Food Products Industries"

IV: ST/ECLA/CONF.23/L.22 "Industries Processing Agricultural Products other than Food"

VI: TE/ECLA/SID/66/VI "FAO's Relations with Industry through the Freedom from Hunger Campaign"

In addition, FAO has collaborated with ECLA in the preparation of all the papers relating to the joint ECLA/FAO Interim Review Consultation on Pulp and Paper Development in Latin America, which is scheduled to form a part of the Symposium.

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C O N T E N T S

FISHERIES INDUSTRIES

Industrial Development in Fisheries

with particular reference to Latin American Fisheries

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Introduction

1. The problems associated with industrial development in fisheries differ in a number of ways from other industries based on renewable natural resources.

2. Fisheries involves exploitation of a raw material source which cannot be seen with the naked eye and thus cannot be as easily quantified as is possible with trees, livestock, or field crops.

3. The catching of fish is a hunting effort in comparison to the harvesting of a land crop. Except for fish stocks whose habitat are in rivers, lakes and territorial marine waters, the resource is available to any nation having the skill, capital, and ingenuity to exploit it. However, fish stocks are not inexhaustable and can be seriously depleted unless proper management practices are applied. This aspect of common property in respect of fishery resources on the high seas, which play an increasingly important role for the world's present and future fish supply, complicates the task of ensuring that their exploitation is in accordance with sound biological and economic criteria. An example of what may happen in the absence of adequate and sufficiently early control measures is provided by the exploitation of the Antarctic whale stocks, both as regards the present biological state of this resource and the economic situation facing the important industry which was built upon it.

4. The raw material is highly perishable. The catching of fish must be closely co-ordinated with facilities for prompt handling, preservation and distribution into the hands of the consumer or to processors who will subject the raw material to treatment to extend its storage life.

5. Modern fishing has become an increasingly technical operation which utilizes highly sophisticated equipment and requires that fishermen be much more skilled than in the past. Also, a modern fishery industry requires substantial capital investment in equipment and facilities to produce the raw material and for utilization.

6. In many areas of the world fishing is still looked upon as a lowly occupation. Relatively large segments of populations are engaged in fishing using equipment of a very primitive nature. These fisheries often are largely a subsistence activity which, in most cases, are very inefficient and of low productivity. While the output of such fisheries can be considerably increased by improving boats and introducing simple but more effective fishing gear and methods, it is difficult to effect major development from such a base.

7. Governments sometimes associate the desire to improve the conditions of a very extensive subsistence fishing population with the objective of developing a productive and viable fishing industry. As a consequence, considerable sums of money can be spent without obtaining the anticipated result. When consideration is being given to the potential role of fisheries in industrial development, it is advisable to differentiate between what may be a necessary and desirable social objective and what is necessary to utilize available fisheries resources to maximum economic advantage in an industrial sense.

Growth of Fisheries Industries

8. The world fish catch has increased by about three-quarters during the past decade and now amounts to approximately 50 million tons annually. Since much of the increase has been due to landings of a lower-value fish for industrial purposes, such as the manufacture of fish meal and fish oil, the expansion in terms of provisional FAO price-weighted indices is somewhat less (about 42 percent). Nevertheless, this increase is much greater than the percentage rise in agricultural production or in the output of most individual agricultural products. In the same period production of agricultural and forest products increased 31 percent and 19 percent respectively. In 1964 the world fisheries exceeded beef and veal production by 16 million tons, and pork production by 25 million tons. Present knowledge of the production potential of the world's oceans and inland waters, although still limited, indicates that a catch much greater than present levels could be attained and sustained if the world fish stocks were fully exploited and in a rational manner.

9. More than half of the rise in fish production in recent years has come from the fisheries of developing countries. The largest rise in production and increase in industrial development has been in the fisheries of Latin America. Fisheries production in Latin America increased by 1,300 percent, comparing the 1952-56 average with the 1964 catch. While in 1952-56 Latin America's share in world production amounted to only 3 percent, in 1964 it had reached 22 percent with Peru the leading producing country. The value of the 1964 catch in Latin America amounted to the equivalent of nearly US $350 million.

10. More than 90 percent of the Latin American catch in 1964 was accounted for by Peru with 9,131,000 metric tons and Chile with 1,161,000 metric tons. Most of the other countries have also increased production during the last 10 years, but not in such a spectacular way. Brazil 400,000 metric tons (estimated), Mexico 260,000 metric tons, and Argentina 160,000 metric tons follow in importance. Colombia, Ecuador, Cuba and Panama are catching between 50 and 25,000 metric tons.

11. It will be seen that the sudden and spectacular increase in the total Latin American fish catch does not represent a general and equally accelerated fishery development in the Region as a whole, nor over all sectors of the fishing industry. Rather it results from a tremendous but extremely narrow concentration of effort in one particular sector - namely the fish meal and oil industry in Peru and Chile.

Some Requisites for Industrial Development in Fisheries

12. Most nations with access to the sea or possessing sizable inland waters are giving increasing attention to developing fisheries industries. Fisheries offer opportunity for increasing the availability of animal protein in the local food supply and for increasing local income. It also represents a potential source of foreign exchange earnings, and a possible base for further industrial development.

13. Although many requisites for industrial development in fisheries are common to those for other industries based on renewable natural resources, there are some aspects of fisheries which are perhaps more critical.

14. Fish stocks, with few exceptions, are not subject to individual ownership. Therefore, it is desirable that there should be an agency in government having specific responsibility for administering and supervising certain fishery activities. Further, the agency should have qualified staff and facilities sufficient to plan and implement research and survey programs, either independently or with outside assistance, to supply types of information which are essential in determining the extent to which development or expansion is justified.

15. Knowledge about the raw material source is especially important in fisheries. Unlike other industries, it is necessary to conduct a hunting operation in order to produce the raw material. Also, in most fisheries, a major proportion of the total capital investment in the industry is required for the equipment and facilities for producing the raw material. Unless there is adequate information regarding the abundance and range of the more important accessible fish stocks, their seasonal occurrence, the most productive fishing areas, the most suitable methods for catching, and the possible yields of these stocks, it is difficult to reliably determine the extent of the fishing effort that could or should be directed to raw material production. This refers to the number, size and types of fishing vessels to be used.

16. Knowledge of market potential and characteristics also is perhaps more critical in fisheries than in most industries based on agricultural and forest products. Rigid consumer preferences, or prejudices, may constitute a serious barrier to accelerated fishery development. For example, it has been seen that new fish species, in some instances the result of extension of fishing operations to more distant waters, have met with considerable resistance, even aversion, from consumers, who are unfamiliar with such species. In one known case it took as much as three years to introduce marine fish, and make it generally accepted in a district where the population previously had known only freshwater species.

17. Due to the high perishability of fish, the effort directed to raw material production must be quite closely correlated with market demand for fresh fish and the facilities available for immediate preservation and processing of that part of the supply which will not be consumed fresh. Thus, the operations concerned with producing the raw material supply and those concerned with handling preservation, processing and distribution are less independent of one another than is possible in many other industries. This has led to a certain amount of vertical integration in fisheries industries in the past and this trend is increasing.

18. In seeing how these general principles have worked out in the progress of industrialization in fisheries in Latin America, it is necessary to draw attention to the main factors bringing about the extraordinary developments which, in a short period, have transformed areas within the Latin American region from relative insignificance to world prominence in terms of quantities of fish caught and products entering into international trade.

19. The most important factor was the availability of enormous homogeneous fish stocks of anchoveta located at convenient distances off the coasts of Peru and Chile. This allowed the application of highly efficient bulk catching techniques (perfected in other fisheries with similar resource characteristics in terms of concentration and behaviour), and mass-production techniques ashore, capable of dealing with the vast quantities landed and turning these into a commercial product of consistently reliable quality.

20. Another factor facilitating this development was the existence of a steadily expanding world market for fish meal for animal feeding. The expansion of demand for this product has been such that market fluctuations which might occur in the immediate future would most likely result from conditions governing the raw material supply rather than the demand for the finished product.

It has been estimated that, if demand continues to expand at its present rate, world trade in fish meal in 1970 would be more than 3 million tons a year. Already in 1964 exports reached 2.3 million tons. Whether demand will continue to grow at this rate will depend on a number of factors, e.g. dependability of supply, competition from other sources of animal feeding (including the possible development of synthetic feeding stuffs which might be encouraged if raw material supplies for fish meal fell short of needs), the possibility of increased consumption of fish meal in some developed countries where the present level is relatively low, and the extension of markets in developing countries, including those in Latin America where livestock industries are being fostered.

Fishing Boats and Fishing Gear

21. The fishing boat equipped with the necessary fishing gear represents the primary tool for raw material production in any fishery industry. Much of the progress that has been made in fishing in developing areas has come from introducing and adapting to local conditions boats and gear which have proven successful in more advanced fisheries. However, it can be dangerous to assume, as has been done in some cases, that boats can be successfully introduced from one part of the world to another without careful study. This includes among others, attention to such practical matters as correlating size with distance to fishing grounds, type of gear to be used, number of crew and fish carrying capacity needed, location of deck equipment, proper protection for the catch, engine power in relation to vessel size, type of gear to be used, maintenance and repair facilities, etc.

22. Since fishing boats normally represent the largest single item of capital investment in a fishery industry, the possibility of supplying these through local construction offers considerable opportunity for developing a supporting industry based on boat building. Advances being made in the development of forest product industries in the manufacture of lumber and marine type plywood in some developing areas are providing highly suitable building materials for wooden boat construction. A number of countries conscious of these possibilities are seeking to have nationals trained in the fields of naval architecture and boat building, and others already have established shipyards engaged in building fishing boats. FAO is contributing to these developments under its technical assistance activities, training courses and technical meetings on fishing boats and resultant publications.

23. The manufacture of fishing net webbing and certain other items required in the construction and/or operation of fishing vessels also offer, in lesser magnitude, opportunity for developing additional industries in support of fishing.

In Peru, Chile, Mexico and Argentina many new fishing boat yards have been built. In the first two countries they are mainly devoted to the construction of purse seiners for the anchovy fishery. In Mexico, their major output serves the shrimp fishery and in Argentina the trawler fishery.

Fishing Harbours

24. As fishing operations progress from small non-powered craft to larger mechanised craft, the matter of adequate harbour facilities becomes of increasing importance. Experience has shown in a number of developing countries that establishing fishing harbours has proved to be a stimulus to fisheries development far beyond what was originally anticipated.

25. A fishing harbour permits greater centralization of fishery activities with all its inherent advantages. By concentrating the catch into major landing ports, it is possible to organize a more effective marketing system and establish more efficient marketing practices. With more boats coming to a centralized place, there is encouragement for and the possibility of establishing better service facilities, including maintenance and repair yards, fueling stations, ice supply, ship stores and fishing supplies. Similarly, the concentration of landings leads to a greater and more regular raw material supply. This permits and encourages establishing facilities for preserving and processing and the development of fish processing industries.

26. In many advanced fishery nations, governments have played a leading role in the planning and provision of central fish landing and marketing facilities, realising that here lies very often the bottleneck to further development. The cost of providing suitable facilities at a large number of small fishing centres would, in most instances, be out of all proportion to the volume and value of the fish being handled. The

provision of basic landing and marketing facilities, including a modern wholesale fish market, is made possible by the concentration of the trade in such volume that the cost can reasonably be recovered at acceptable levels of price.

27. In most advanced fisheries, such facilities are usually looked upon as social capital, the function of which is to stimulate fishery development. They do not, therefore, as a rule, bear profit directly for the entrepreneur, but are always required as the basis of economic development. Their socio-economic functions and the high capital cost involved is perhaps the main reason why governments in many countries have found it necessary and appropriate to assume responsibility for the planning, financing, construction, and, to a large extent, administration or supervision of administration of such facilities. If this were done by private industry, one might, in view of the very considerable capital requirements involved, be faced with serious waste of capital through unnecessary competition, or, on the other hand, a situation of monopoly through lack of competition. The latter condition perpetuates certain unattractive practices of traditional fish marketing systems through which the fisherman becomes completely dependent on the owner of facilities required to land and market the fish. The usual arrangement is that the necessary ground in suitable fish landing areas and primary facilities, such as landing facilities, market halls, etc., are provided by the government which, again, provides the incentive and indeed the necessary basis for private industry to move in and establish all the secondary facilities and services, including processing, required for the efficient balancing of supply and demand.

Handling and Preserving the Catch

28. Due to the rapidity with which fish spoils, especially in tropical climates, it is necessary that the catch either be consumed fresh within a period of hours or be subjected to some method of preservation which retards spoilage. This creates a need for facilities for preserving and handling the catch if a fishery industry is to reach any appreciable stage of development. The type of facilities and services may vary depending on the use to be made of the raw material.

29. For a modern, progressive food fish industry, the use of ice during handling and distribution is in most cases indispensable. In addition to space for preserving and handling the catch, it is obvious that provision should be made for chilled storage of iced wet fish. The supply of good quality fish to industrialized processing plants requires fishing boats or carrier vessels either with chilling facilities or which are fast enough to deliver fish to the plants in the freshest state possible.

30. The application of ice for the preservation of fish in the tropics is not more difficult than in moderate climates. Ice may have an even greater effect on the retardation of spoilage of fish caught in tropical waters if it is used in sufficient quantity. It is quite evident that a greater amount of ice is required at higher ambient temperatures. Ice and iced fish should be protected as much as possible during transport against the direct influence of the sun and the warm air.

31. Ice can be produced as block ice, flake ice, tube ice and in other physical form. Each type has its advantages under certain conditions. Block ice is preferable if ice has to be transported under unfavourable conditions prior to use, since the smaller exposed surface area minimizes loss due to melting. Block ice, however, must be cracked for icing fish. Small ice, such as flake, tube or snow ice, is more convenient for markets or for re-icing of fish during transport. Flake, tube and even snow ice can be used successfully for icing fish aboard vessels if proper procedures are used.

32. The requirements for ice in handling and preserving the catch as "wet fish" in a developing fishery can provide the stimulus for either the introduction or the expansion of an ice manufacturing industry at fishing ports.

Fish Processing Industries

33. Fish which are not to be consumed fresh may be preserved or processed by one or more of several methods, depending on the conditions pertaining. The principal methods are freezing and frozen storage, canning and curing. The latter includes such processing techniques as salting, drying, smoking and fermentation, or some combination, as for example salting and drying. Also fish which can be caught in sufficiently large quantity at very low cost, and waste and trimmings from food fish processing, are used to manufacture fish meal and fish oil.

34. Latest FAO statistics (1964) on the disposition of the world catch of fish indicate that 33.7 percent of the catch is consumed fresh, 9.7 percent is preserved by freezing and frozen storage, 16.3 percent is preserved by curing, 8.5 percent is processed by canning, 29.9 percent is used in the manufacture of fish meal and fish oil and 1.9 percent is used in other ways.

35. Statistics on the disposition of fish taken by Latin American countries indicate that only 17 percent of the total catch is utilized for human consumption against 73 percent for the world as a whole. In 1963, of that part of the catch of Cuba, Mexico, Argentina, Chile, Colombia, Ecuador, Peru and Venezuela, used for human consumption, the disposal was as follows: fresh 56.1 percent, frozen 15.9 percent, cured 10.9 percent and canned 27.9 percent.

36. In planning the development of fish utilization in Latin American countries, the extreme perishability of fish indicates the need for a careful balancing of supply and demand in time and space, in view of the climatic conditions; the general economic development including power supply, storage and transport facilities; and the availability of markets for the various products. While traditional processing can be undertaken economically on a periodic basis, industrial processing as a rule cannot, due to the necessity for a regular supply or raw material, the high cost of capital equipment and the need to keep higher paid, specialized technical personnel continuously employed. It is essential to determine at what stage activities can be concentrated in order to justify the provision of facilities for centralized landings, large-scale processing and quick distribution over long distances, since the conditions which have led to the development of modern fish processing industries generally do not prevail where fisheries are little developed.

37. In the plans of work of the several fisheries projects under way under the auspices of the United Nations Special Fund and FAO, due consideration has been given to problems related to fish preservation in regard to distribution and marketing requisites. Several feasibility projects are under study for development of private or public ventures in the field of canning, curing and freezing, some of which, it is hoped, will eventually be financed by international agencies such as the Inter-American Development Bank and the International Bank for Reconstruction and Development (IBRD).

Fish Curing

38. Curing methods have their place in all fisheries of the world and offer possibilities to produce a wide variation of products ranging from simple salted and sun-dried fish to delicacies, such as smoked salmon and caviar, which shows that these methods can be applied to a wide range of species. Inexpensive equipment can be used, which can be manufactured locally or easily operated.

39. There are, however, limitations to the use of curing methods connected with climatic conditions prevailing during processing and distribution. Unsalted dried products and smoked fish are difficult to protect against beetle infestation during storage and transport. In areas where cured products are not already known, marketing problems arise in respect of consumer acceptance.

40. The importance and usefulness of curing methods in developing countries are not always recognized and these methods often do not have their appropriate place in development programs. In the efforts to provide fish as a source of valuable protein to populations with low purchasing power, improvements under prevalent conditions should be initiated, especially in areas where the traditional curing methods cannot be replaced in the near future. Moreover, new arrangements for the use of improved methods and equipment suitable for curing in bulk should be made. Products can be improved and, depending on the stage of development of the curing industry, adapted according to the changing taste of the consumer. Such arrangements would gradually pave the way to industrialized processing using mechanized equipment.

41. There is a good market for salted and dried fish in many countries in Latin America and the development of this industry should be encouraged. At present imports from Europe amount to about 30,000 metric tons per year. Successful experiments on the manufacture of fish sauce for human consumption have been made in Ecuador and Chile.

Fish Freezing

42. Freezing is at present the only method which can preserve the fresh fish characteristics during long storage. In addition, it offers, if applied on a large scale, the following advantages common to industrialized processing:

Consistent quality
Products variety
Possibility to stabilize supply and price
Hygienic packaging and distribution
Standardization of product type
Extension of range of retail outlets
Providing an incentive for individual manufacturers to use modern advertising

43. These obvious advantages of freezing over chilling make the widespread interest in developing countries towards establishing fish freezing plants and frozen storage facilities understandable. On the other hand, the initial capital investment is high and the costs of storage and distribution are substantial if fish is properly stored in a cold chain. It is, therefore, essential to determine not only the cost and type of any particular processing equipment and methods, but also the type and cost of facilities and services required after the stage of landing and processing in order to bring the products to their final destination, that is the consumer, in a satisfactory state. Thus, the possibilities of marketing frozen fish are directly related to the capacity and geographical range of cold storage distribution facilities, including transport, both at the wholesale and retail stages, and, to some extent, also to the number of consumers possessing a refrigerator in their homes. If no such chain exists, one will have to consider very carefully the economic implication of establishing such a chain based on frozen fish distribution alone. Usually the cost is too high and the possibility of frozen fish distribution is, therefore, to a large extent, determined by the stage of development in other frozen food lines.

44. The application of a freezing process before storage at low temperature is an established and recommended practice. The freezing temperature for fish is in general -35° to -40° C. The fish should remain in the freezer until it is cooled at the thermal centre to -15° C or lower. The freezing rate is, within a certain range, of little influence on quality, but the freezing of fish at too slow a rate by simply placing it in a cold store or by partial freezing will result in deterioration of quality. If quality is of limited concern, and the main need is just to prevent spoilage, any freezing practice may be applied, but such a procedure should not be considered a generally recommendable one.

45. Storage time and storage temperature are, in addition to the fresh quality of the fish before freezing, the most important factors in ensuring good quality at the retail market. The generally accepted maximum temperature for the storage of frozen fish is -18° C but there is evidence that in the tropics even -20° C is insufficient as a maximum basic storage temperature. Different storage times require different storage temperatures.

46. There are good possibilities in many countries in Latin America of increasing exports of frozen fish to Europe and other continents. Countries such as Argentina and Chile have already developed an important and modern freezing industry. A limited trade of frozen tuna-like species is taking place between Chile and Argentina for the supply of raw material to the canneries of Mar del Plata.

47. Mexico has developed an important shrimp industry based on exports, mainly to the United States. In 1964 the total value of these exports amounted to US $ 52.7 million, ranking among the most important of the products exported from that country.

Fish Canning

48. Canned products, as opposed to frozen products, need no special marketing facilities; their keeping qualities, when they are fully sterilized, are almost unlimited, and they can be marketed anywhere by anyone under any conditions. Such products have, therefore, immediate access to a wide range of existing transport and intermediate storage facilities at low cost through all stages of the trade, including all types of retail outlets, which, of course, greatly enhance their immediate marketing potential compared with products for which specialized and expensive marketing facilities are required.

49. Canning also offers a comparatively wide scope in adapting products to specific consumer preferences in respect of texture, tastes and flavours or in disguising inherent raw material characteristics which may be unfamiliar or unpopular. This, of course, greatly facilitates the introduction and marketing of the product, and it also offers a better opportunity of utilizing species which would have met with consumer resistance had they been marketed with their natural characteristics.

50. A generally known handicap is, however, the high cost of tin plate required for the containers, especially in countries where tin plate is not produced. In developing countries where the average level of income may be quite low, the cost of the container, which may be considerably greater than that of the contents, can quite easily offset the low cost of storage, distribution and marketing.

51. Pre-investment studies should be made on the application of canning under the current economic situation in the country and on the fish available. Regularity of supply and good quality raw material are of special importance. The capacity of the plant and the number of months during which it can be utilized each year must be decided and information on the quantity and regularity of supply, species suitable for canning, etc. must be available.

52. Not all species of fish are equally suitable for canning nor for the same type of canned product. Fish products development is, therefore, one of the prime requirements before decisions concerning the establishment of a cannery are made. Developing or finding markets for the products is of equal importance.

53. The market for canned fish in world trade involves relatively few species and types of products. Most of these products have a long history of acceptance and have become quite firmly standardized in the minds of the consumer. Unless it is possible to duplicate these products both with respect to raw material and methods of packing, canned fish offered for export is very likely to encounter very limited market interest.

54. In Latin America, mainly Argentina, Brazil, Chile, Peru, Ecuador, Mexico and Venezuela have developed a fish canning industry of sizable proportions. In 1964 the exports of canned products amounted to US $15 million.

55. For local consumption, processing operations and products specifications or standards may be established, according to local conditions and requirements. The basic rules of maintaining highest nutritive value, food hygiene and plant sanitation should be followed. The type of product must conform to local tastes. In Latin America major problems in this field are still of standards and quality both for the containers and the final product.

Fish Protein Concentrates

56. Although still in the development stage, the production of fish protein concentrates offers the possibility of providing at a relatively low cost a protein rich food of high nutritive value and long shelf life. An additional advantage of these products is that they can be packed and transported easily. They can also be protected more easily against spoilage and beetle infestation than cured fish. Non-deodorized and non-defatted products suitable to be used as condiments can be produced in a simple, satisfactory and inexpensive way. Defatted and deodorized products require more complicated processing methods and should be produced from inexpensive fish species in order to keep the cost of the product low. The development of simplified processes for industrial production is under continuous investigation by technologists and process engineers.

57. At present, large-scale manufacture of fish protein concentrates for human consumption is handicapped by lack of a regular commercial market, although there is a strong need for such products in many developing areas. On the other hand, market development has lagged, due to lack of a suitable product which can be made regularly available in sufficient quantities for promotion and introductory programs in the commercial market.

58. So far, most of the efforts in testing and introducing various types of fish protein concentrates have been carried out within an institutional framework. In Latin America, projects for the development of fish protein concentrates are under study in Peru, Chile and Uruguay.

59. The successful conversion of part of the huge quantities now being produced into fish meal for animal feeding to fish protein concentrate for human consumption (which would be easy and cheap to transport and store, and which could be adapted to local preferences or incorporated in local diets without affecting taste and flavour) coupled with the removal of barriers to trade in fish and fish products within the Region, could make an important contribution to the improvement of nutritional standards in the Region, and would be of great economic benefit to the fishery industry as well.

60. It has been calculated that the amount of animal protein contained in the fish meal exported from Peru and Chile is equivalent to practically the total current animal protein deficit of the entire Region.

Manufacture of Fish Meal and Fish Oil

61. The most rapid expansion in fish processing industries during recent years has occurred in the manufacture of fish meal and fish oil. At the present time, one third of the world catch of fish as such, plus the trimmings and waste from processing fish by freezing, canning and curing are being converted into these products. Fish meal is utilized almost exclusively as a source of high quality protein in animal feeding and the fish oil is utilized for a number of industrial and food purposes.

62. A primary requirement for developing an industrial operation based on the manufacture of fish meal and fish oil is to have a plentiful and very low cost source of raw material. This means that unless trimmings and waste from food fish processing are to be used only species of fish which occur in great abundance and are readily accessible to highly productive types of gear can be considered. Due to the usually much higher price which can be paid for food fish, it is only under very unusual circumstances that establishing a fish meal plant could contribute to sustaining food fish prices during periods of temporary overproduction.

63. Approximately 83 percent of the Latin American fish catch is presently being utilized in the manufacture of fish meal and fish oil. This extraordinarily high percentage is, however, due to the enormous quantities of anchoveta caught by Peru and Chile being almost exclusively used for fish meal and oil. The products are largely sold in export and represent an important source of foreign exchange, amounting to about 180 million dollars in 1964 for these two countries.

64. The extent to which fishery industries based on the manufacture of fish meal and fish oil can be increased in Latin America will be determined by whether present catch rates can be sustained, and whether marine resource research and experimental and exploratory fishing will demonstrate the existence of additional stocks of fish which can be caught in sufficient abundance at low cost.

Summary

Potentialities for Fishery Development in Latin America

65. Although foreign capital and know-how were attracted by the sector which showed the most promising and immediate opportunities of high economic returns, the subsidiary effects of rapid industrial development in Peru and Chile on the development of other sectors of the fishery industry in the Region should not be underestimated. Technical skill and experience in catching and processing, although largely confined to one sector at present, can be transferred to others. There is evidence, too, that industry and governments are becoming increasingly aware of the hazards involved in concentrating investment in one single resource and type of product. The recent difficulties in the Chilean fish meal industry due to shortages of raw material, have brought this lesson home, and emphasized the importance of balanced development. Governments in the Region are, moreover, increasingly aware of the potential contribution which fishery development can make to the national economy in terms of employment, improved nutrition and foreign exchange earnings.

66. The increased interest and awareness of the potential contribution from fisheries among governments in the Region has been reflected in a growing number of requests, to FAO, from many countries for technical assistance in surveying and appraising their fishery resources, and showing how these resources can be efficiently exploited. The problems to be covered range from biological research, experimental and exploratory fishing to determine suitable types of vessels and gear, processing methods and equipment, distribution and marketing, etc.

67. The complexity of these problems calls for an integrated approach and systematic studies and investigations by a team of experts over an extended period - normally several years. This can best be achieved within the framework of United Nations Development Program Special Fund projects, and the number of such projects in the field of fisheries in operation in the Region or under preparation is therefore increasing steadily.

68. What has happened in Peru and Chile has tended to over-shadow more modest but still significant achievements in other fields. A feature of development in some countries, for example Mexico and Ecuador, is the relatively recent development and growing importance of exports of certain high-priced luxury species, chiefly shrimp and lobsters, principally to the U.S.A. The value of these export items from the Region, which exceeded US $80 million in 1963, are to some extent compensated by imports from outside the Region of lower-priced products, especially salted and dried fish, valued at about US $45 million in that same year (almost double the value of these imports in 1961). This trend suggests that the market for fish products within the Region is capable of expansion if products of appropriate type, quality and price can be made available from local production through improvement of processing and marketing in general. However, in many of these countries, fishery development has, through lack of a national market for these valuable species, and in order to earn foreign exchange, been directed to the export market. Participating foreign capital has also encouraged such a trend. On the other hand, it is probable that species at present not exploited or discarded during fishing operations could be utilized for sale on domestic markets, and thereby relieve the shortage of animal protein as well as provide a useful supplementary income to the fishing industries.

69. The Region is the second largest producer of all regions in the world, accounting for 19 percent of the total world catch in 1963 (22 percent in 1964), but only 4.5 percent if the comparison on both sides is restricted to quantities used for human consumption. The Region has the highest annual per capita production of all regions (38.5 kg), but the lowest in terms of quantities produced for human consumption (6.5 kg, of which a considerable share is exported). Of the 15.3 million tons of fish and fish products (live weight equivalent) entering world exports in 1963, 44.4 percent came from the Region, representing 77.3 percent of the total regional catch, whereas the Region itself received only 2 percent of total world imports.

70. The value of fish meal and oil exports from Peru and Chile reached some US $180 million in 1964. These foreign exchange earnings are, of course, of considerable economic importance to the countries concerned. However, fish meal and oil represent a relatively low-value utilization of fish, and the dramatic expansion of these fisheries considered in the light of nutritional needs in the Region provokes consideration of whether they could not be utilized for human consumption to a greater extent than at present. In the Region, and particularly in Peru and Chile, there is, in fact, considerable interest in the manufacture of fish protein concentrates for human consumption, and FAO in collaboration with UNICEF has been seeking ways and means to promote the manufacture and consumption of such products.

71. While Latin America's position in world fisheries will continue for some time to be largely a reflection of what happens in the industrial fisheries of Peru and Chile, encouraging developments in other countries indicate that the future pattern of production may be directed more to the satisfaction of local nutritional needs than heretofore. In Chile and Peru themselves increasing efforts are being made to develop fishing for domestic food supplies, and development programs in Argentina, Brazil, Ecuador, Colombia, Venezuela, the Caribbean, Central America and Mexico, all pay particular attention to the possibility of increasing supplies for domestic consumption.

Inland Water Fisheries

72. Although much that has been said above relates to marine fisheries, the potential importance of inland water fisheries in the Region should not be overlooked. In 1963, freshwater species represented a little more than 2 percent of the total regional catch of all fish and shellfish. This percentage is substantially increased to 13 percent if the catch of freshwater species is compared with the total catch of marine fish utilized for human consumption. Mexico and Central America take the lead in the development of their inland water fisheries resources. Bolivia, Brazil, Peru and some Caribbean countries are showing a growing interest in the potential of their freshwater resources, and some advances have been reported in fish and shellfish culture experiments and practices.

Extensive hinterland areas in the Andean plateau with an important network of lakes and rivers permit exceptionally good natural environments for wild stock exploitation and/or other more rational forms of stock improvements for very valuable cold water species which could be used for commercial and subsistence purposes.

Tropical inland water fisheries should also have good prospects in areas which have no easy access to fish supplies from marine sources. Fish culture in ponds still represents a minor activity in this Region, and practices of combining fish farming with crop production are ignored or disregarded in agricultural activities.

Fish culture has a number of operational advantages not always fully recognized, such as relatively low initial capital cost and depreciation rates (once the necessary facilities have been set up they can be used almost indefinitely with proper care and maintenance), relatively simple operating techniques, low transport and distribution costs (as opposed to transporting fish from the coast to inland regions), effective control of supply in relation to demand (as opposed to marketing difficulties created by uncontrollable daily and seasonal fluctuations in marine fisheries), a minimum of waste, freshness of quality, etc.

At present, however, only a tiny fraction of the potential cultivable inland waters is used for fish culture and even a modest production per hectare would make a very considerable increase in total supplies of fish for human consumption in the Region.